



## INPHAZE Users and Their Projects

### Solar Cells

The Economic Development Board of Singapore and the National University of Singapore have jointly established the Solar Energy Research Institute of Singapore (SERIS) in 2008 to boost Singapore's role in the solar energy sector. SERIS will focus on applied research in the field of photovoltaics and energy efficient buildings, including advanced characterization of various types of solar cells. SERIS' Characterization Laboratory is headed by Dr Bram Hoex and as the main tool an **INPHAZE** HiRes-EIS system has been acquired. A close collaboration is now ongoing between **INPHAZE** and SERIS to further develop the use of EIS in the field of photovoltaics.

The University of New South Wales in Australia hosts one of the world's foremost photovoltaic research centers, headed by Prof Martin Green. The **INPHAZE** system has been used to characterize photovoltaic cells produced by this group, and shown some very interesting results. (Discussed in the **INPHAZE** Photovoltaic Cell Application Note.)

**INPHAZE** is also cooperating with one of the key solar cell research groups in Germany, at the Max Planck Institute for Microstructure Physics in Halle.

### Membranes and Membrane Fouling

Water desalination and reclamation plants are based on the use of reverse osmosis membranes (RO). Researchers at the University of Sydney have shown that the **INPHAZE** HiRes-EIS systems are capable of distinguishing fine detail in these membranes, as well as detecting fouling of the membranes at a very early stage in the plant running cycle. (*Fouling of reverse osmosis membranes using electrical impedance spectroscopy: Measurements and simulations*, J.M. Kavanagh, S. Hussain, T.C. Chilcot, and H.G.L. Coster, *Desalination*, 236, 187–193, 2009). As a novel fouling detector for membranes, the **INPHAZE** instrument offers potentially large savings in energy usage and improved productivity.

Based on these preliminary findings, a major collaboration is commencing between **INPHAZE** and the Singapore Membrane Technology Centre (SMTC) headed by Professor Tony Fane at Nanyang Technological University.

### Mineral Processing

The **INPHAZE** instrument can also be used for characterizing particles in mineral flotation, and this will be demonstrated in a new cooperation with the Ian Wark Research Institute in South Australia and a special sample chamber is been constructed for this application.

### Batteries & Fuel Cells

Batteries have become of great interest to bring about more efficient energy usage. One of the R&D challenges for batteries, and fuel cells, is the optimization of the membranes used. Several of groups are using the **INPHAZE** system to characterize their low impedance membranes. Collaborative projects have just commenced.

### Bionics

**INPHAZE** is engaged in an ongoing research collaboration project with leading aural implant company Cochlear. Surface coatings are being tested with the goal of improving the Cochlear hearing implant devices.

### Nanotechnology/Organic Thin Films

The research group of Prof Michael James at the Bragg Institute of ANSTO (Australian Nuclear Science and Technology Organisation) studies thin films, surface coatings and self-assembled monolayers (SAMs). The key is to functionalize silicon wafers and other substrates for the development of biocompatible materials and in bio-sensing applications. (*Characterisation of Alkyl-Functionalised Si using Reflectometry and AC Impedance Spectroscopy*, E.L.S. Wong, M. James, T.C. Chilcott, and H.G.L. Coster, *Surface Science*, 601, 5740–5743, 2007.)

A set of complimentary technologies: **INPHAZE** HiRes-EIS, X-ray reflectometry, and neutron reflectometry are being employed for these studies. A new sample chamber for simultaneous impedance spectroscopy and neutron beam experiments has been developed.

### Polymers and Bio-Polymers

It has recently been shown that thin layers of polystyrene can be characterized efficiently with the aid of the **INPHAZE** instrument.

This line of work is now being extended to polyamines at the University of Sydney, in the research program headed by Prof Marcela Bilek and Prof Tony Weiss, to develop high-performance surface coatings. Their goal is to create biocompatible surfaces for medical devices. The **INPHAZE** spectrometer is being used for surface characterization.

### Cell Membranes

At the Ian Wark Institute in South Australia, Dr Dusan Losic and his group are developing nanopore and nanotube materials for applications in molecular separation, biosensing and drug delivery. They are using the **INPHAZE** HiRes-EIS system as one of their characterization

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techniques to study molecular transport and the electrical properties of their new materials and devices.

Dr Losic has found that HiRes-EIS, performed with **INPHAZE**, is particularly valuable for the study of biomimetic membranes as well as for the study of membrane–drug and membrane–protein interactions. These are stepping stones towards biodiagnostic devices for drug screening and drug discovery and biosensing.

Cell membrane work with the **INPHAZE** instrument is also being carried out at ANSTO in the research group of Distinguished Researcher Prof Richard Banati. One project is researching hybrid lipid bilayers bound to self-assembled monolayers (SAMs) which themselves are bonded to silicon.

### Cell Biology

Dr Guo Jun Liu is a Senior Research Fellow working with Prof Richard Banati and is using the **INPHAZE** HiRes-EIS system to study the neuronal and glial cells in the central nervous system. The aim is better understanding of neuronal diseases at the cellular level, as well as drug design. A special sample chamber for cell biology studies has been designed, adapting the INPHAZE system for routine cell biology experiments.

A protein binding feasibility study for Macquarie University was undertaken to show that the binding of glycoprotein to bacteria could be studied with the **INPHAZE** equipment. Funding is being sought to move this research forward.

**INPHAZE** HiRes-EIS is valuable tool for the study of protein–protein interactions using the human protein, tropoelastin, as a model. Parallel measurements comparing a Biacore plasmon resonance instrument and an **INPHAZE** spectrometer were performed which showed

that the **INPHAZE** equipment not only yielded comparable structural information, but additionally provided valuable quantitative data on protein binding kinetics.

### DNA

The **INPHAZE** HiRes-EIS system can distinguish between single-stranded and double-stranded DNA (*Electrical characterizations of biomimetic molecular layers on gold and silicon substrates*. T.C. Chilcott, E.L.S. Wong, T. Böcking and H.G.L. Coster, *Physiological Measurement*, 29, S307–S319, 2008). This work is about to be extended at the University of Sydney by Dr Ali Abbas and his team, with the goal of developing a new DNA biosensor designed specifically for forensic applications of human bone material and for the detection of genetic mutations.

### Impedance Tomography

At University College London the group of Prof David Holder studies the human brain by means of tomography. One of the researchers of this group, Dr Alistair McEwan, has now moved to the University of Sydney and established a collaborative group that uses the **INPHAZE** HiRes-EIS system with a specially designed multiplexer for tomography experiments.

In addition to the work on the human brain, Dr McEwan is also investigating the feasibility of using impedance tomography to detect breast cancers.

### INPHAZE Key Specifications

Impedance range:	0.1 – 10 <sup>10</sup> ohm
Phase resolution:	0.001 degrees
Magnitude error:	0.002%
Frequency range:	0.001 – 10 <sup>6</sup> Hz
Configurations:	2, 3, or 4–electrode
<i>Specifications may be altered at any time. Please confirm with your vendor.</i>	



WARRANTY: INPHAZE hardware units are supported by a two year warranty

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